

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

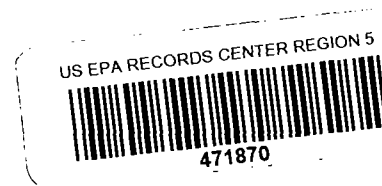
INTEROFFICE COMMUNICATION

December 15, 1993

TO: Gene Hall, Project Manager
Site Management Unit 2
Superfund Section
Environmental Response Division

FROM: Robert L. Delaney, Jr., Geologist
Superfund Support Unit
Geological Services Section
Environmental Response Division

SUBJECT: Response to Rauland Sharp's September 3, 1993 Letter,
Proposed Additional Hydrogeologic Investigation,
Albion/Sheridan Township Landfill, Calhoun County



At our November 22, 1993 meeting between representatives of MDNR, EPA and WW Engineering & Science, I was asked to develop an evaluation of Rauland Sharp's proposed additional hydrogeologic investigation for the Albion/Sheridan Township Landfill site which he had presented to MDNR in his letter of September 3, 1993.

Mr. Sharp did not present in his letter an explanation or rationale for the additional work that he proposed. Additionally, he did not explain why many of MDNR's proposals as presented in MDNR's August 10, 1993 letter to Mr. Sharp, were not incorporated into his proposal. Finally, Mr. Sharp's proposal would not be implemented until design was initiated.

Mr. Sharp's proposal does not address MDNR's concerns. The proposal will not address very serious gaps in our understanding of the aquifer under the site, contaminant distribution and transport. These gaps are sufficiently serious that remedy selection at this stage could jeopardize the success of the project. We would continue to support the proposal that the Department transmitted to EPA on August 10, 1993 (Attachment #1).

However, we would like to present a more detailed explanation of why we feel it is critical that additional investigation take place before a feasibility study be undertaken.

History of the Investigation

Initially, the hypothesis that guided the work plan development for the Albion site was that, the landfill was only impacting the shallow glacial aquifer. The groundwater flow in this aquifer was expected to flow to the south where it would discharge into the North Branch of the Kalamazoo. The underlying Marshall formation aquifer would be protected from impact by either a protective aquitard at the base of the glacial aquifer, and/or from upward head from the Marshall as the two aquifers discharged to the river.

This was a very reasonable hypothesis given what was known about the site. MDNR's only concern at the time was that, if DNAPL producing chemicals were disposed of at the site, then they might not flow with groundwater. But otherwise, this was a good working hypothesis.

However, analysis of the hydrogeologic investigation results has clearly shown that this hypothesis is incorrect in numerous ways. In order to make it easier to understand MDNR's recommendations, I will outline our understanding of what is happening in the aquifer.

Hydrogeologic/Geochemical Environment

The first fact that indicates that the aquifer and contaminant transport mechanisms are not consistent with the hypothetical model is that, the plume has been found to descend into the Marshall formation. Neither a protective aquitard nor upward heads are preventing this downward migration of contaminants into the regional aquifer system. Results of chemical sampling presented in the attached EPA figure 50 (Attachment #2), clearly shows a specific conductance plume diving into the bedrock in the groundwater recharge zone.

Secondly, groundwater flow in the upper glacial aquifer was not heading directly south towards the Kalamazoo River, but rather had a strong, westerly component of flow. Thirdly, groundwater flow maps of both the weathered bedrock and shallow bedrock showed extremely flat gradients in the west/southwest area of the site (see attached maps [Attachment #3], areas around monitoring wells MW 3, MW 4, MW 6, MW 7, MW 8, MW 9, GRS-2, GRS-3 and GRS-4).

It is therefor evident that groundwater and contaminants are not flowing directly to the Kalamazoo River. The extremely flat gradients in the weathered bedrock and the shallow bedrock are indicative of recharge zones. This would mean that this location, although near to a potential discharge zone (the Kalamazoo) is actually a conduit of recharge to the bedrock aquifer from the contaminant impacted glacial aquifer. The significance of these initial findings is that, the Marshall formation is being impacted by the site and contaminant transport is much more complex than initially thought.

Additionally, an analysis of groundwater flow in the glacial aquifer, on the northern side of the landfill, indicates groundwater flows almost directly to the west. Solving three point problems using LB 1, MW 3 and MW 1 for several dates shows that flow in this region is to the west, and not to the south, as would be expected if the discharge point were the North Branch of the Kalamazoo (Attachment #3). It would seem unlikely that this flow can be accounted for using the original hypothetical model. And I believe that the data presents a much more plausible explanation (which I will explain later) for this flow direction.

Another significant hydrogeologic aspect of the site that is impacting contaminant transport, and possibly leading to a misunderstanding of contaminant distribution, is the effect of what appears to be a perched aquifer at the MW 8 location. Groundwater elevations in MW 8 SG have consistently been approximately 8 feet above groundwater elevations in the glacial wells in the vicinity. There is a thin clay layer at the 953 foot elevation that is maintaining a perched aquifer. The consultant also indicated in their report that there was likely a perched aquifer at MW 6. However, the well log does not indicate a perching layer above the glacial aquifer water table.

What the data indicates is that the area around MW 8 and MW 6 is a discharge zone for the perched aquifer. It appears to be discharging to the glacial aquifer and causing a mounding effect. This mounding appears to impact the glacial aquifer as far as MW 7 (see Attachment #3). A careful analysis of the weathered bedrock

and shallow bedrock aquifers also show the effects of this mounding (see attached maps). MW 8 WB and MW 8 SB fairly consistently shows this mounding. To a lesser extent MW 6 WB, MW 6 SB, and MW 9 SB have shown impact from this mounding.

One additional hydrogeologic condition at the site, that helps explain what is happening with groundwater flow, is that static water level data from the Orchard Knoll monitoring wells clearly indicate groundwater flow toward the northwest in the bedrock aquifer. Static water level data from the ABB report done for the MDNR indicated groundwater flow toward Monitoring well GRS-1/MW 1. Although on the occasions that GRS 2 and GRS 4 static water level measurements were taken by WW Engineering for Albion Landfill site, static water level maps indicated potential flow in this direction, there was little data to do a detailed analysis. However, the conclusions drawn from the ABB data and the limited, but confirmatory data from WW's investigation, was highly suggestive that groundwater in the Orchard Knoll area was being drawn to the northwest; potentially by the Magraw Edison well.

In order to attempt to confirm this, MDNR staff again attempted, on December 13, 1993, to locate all four monitoring wells in the Orchard Knoll area in order to take a round of static water level measurements. All four wells were located and a round of statics were taken (see Attachment #4). Contours of this data clearly indicate flow toward the northwest (see Attachment #5 of December 13, 1993 SWL contours).

Two other pieces of information are important also. The historical records of the Orchard Knoll Site showed that contamination there consisted of refrigerants (freon) and 1,1,1 TCA and 1,2 DCA. Freon was detected in the groundwater coming from the Albion site. These contaminants were potentially dumped at the landfill site and are consistent with what one would expect considering the types of industries that used the landfill.

Secondly, it has been recognized by the consultant that fracture zones exist at the site and are likely having a large influence on the ground water flow in the bedrock at the site.

Conclusions

The following is MDNR's interpretation of the hydrogeology and contaminant transport at the site.

Leachate, generated by the site, enters the upper glacial aquifer. It moves with groundwater flow toward the west on the northern side of the site and towards the southwest on the southern side of the site. The contaminated glacial aquifer recharges the bedrock aquifer (see Attachment #6 from Jim Heinzman to Gene Hall dated July 16, 1993.) Under the site in the south and, very likely, to the west of the site in the north. The contaminant plume to the south west of the site (MW6 and MW9) appears to be driven deeper to overcome the effects of the mounding caused by the discharge of the perched aquifer into the glacial aquifer near MW 8 and MW 6. Contamination in the glacial aquifer and bedrock aquifer near MW 3 is likely moving toward the west and northwest in a trough toward the Orchard Knoll subdivision. This is likely the result of a preferential flow path (along fracture zones) in the bedrock that is being influenced by the Magraw Edison pumping well.

The discharge of perched water near MW 8 to the glacial aquifer may be acting as a partial hydraulic barrier, and is also likely diluting the plume in the areas of Monitor wells MW 8 and MW 9 and potentially at MW 6. EM 34 data may support the conclusion that a plume moving to the west bifurcates before arriving at MW 8. However, such an analysis is highly tenuous because of the effects of topography and the fact that the surveys did not cover as far north as MW 3.

MDNR feels that there are fairly strong reasons to believe that there is contaminate flow to the northwest. This may be the main axis of the plume and the possibility should be investigated.

Recommendations

MDNR believes that our recommendations made in Gene Hall's August 10, 1993 letter to Mr. Rauland Sharp should be followed (Attachment #1). It would likely be wise to include provisions for additional work beyond our recommendations to the west/northwest of the site if it is confirmed that contaminants are moving away from the site in this direction. During the Orchard Knoll investigation investigators failed to vertically sample the aquifer and there are an insufficient number of screened intervals to form a complete picture of the aquifers in this direction.

Additionally, because of the effect of mounding near MW 7 on the southern border of the site and the apparent bifurcation of the arsenic and iron plumes in the unconsolidated materials between a western component and a southern component, and the very strong downward head at MW 5 another nest of wells should be installed to the east of MW 7.

Attachments

cc: Jim Heinzman, ERD

